THERMOCOUPLE REFERENCE JUNCTION

MODEL: LRJR43-4TT-751

SERIAL NUMBER: 16360

MANUAL

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INSTRUMENTATION FOR MEASUREMENT AND CONTROL

PACE *engineering company*

THERMOCOUPLE REFERENCE JUNCTION

MODEL: LRJR43-4TT-751

SERIAL NUMBER: 16360

13035 SATICOY STREET NORTH HOLLYWOOD CALIFORNIA 91605 TRiangle 7-0727 TWX 213-765-5299

MODEL LRJ43 LABORATORY ICE POINT REFERENCE JUNCTIONS

INTRODUCTION

Thermocouples are widely used in industry and research as a convenient and accurate means of measuring temperature in terms of an analog low level voltage. In a typical thermocouple temperature probe, the measuring tip, a junction of two appropriate metals, forms one end of a loop in which a thermoelectric voltage is developed when a temperature difference exists between the probe end and remote end where the loop is completed. Thus, in measuring an unknown temperature with the probe, it is not sufficient to determine the voltage in the loop; it is also necessary to know the temperature of the remote or 'reference junction' end.

Figure 1 illustrates a typical measuring circuit in which the thermocouple loop is opened at the reference end by making two separate junctions with copper in a constant temperature location. This arrangement allows the introduction of a millivolt potentiometer or other meter for measurement of the thermoelectric voltage without the complication of effects due to varying temperature that would occur if the thermocouple lead wires were terminated at the meter.

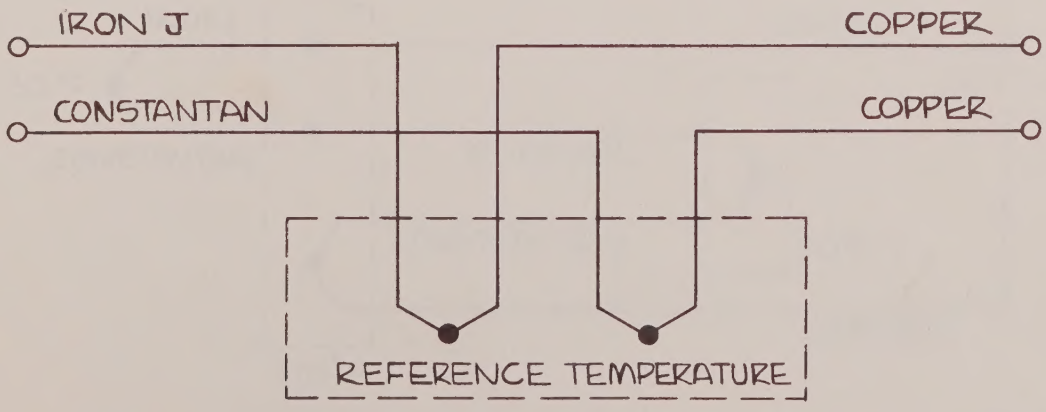

Figure 1

MODEL LRJ43 LABORATORY ICE POINT REFERENCE JUNCTIONS

To extend the utility of the heated reference junction by making possible below-ambient temperature reference, Pace Engineering Company has developed a reference junction system utilizing two fixed temperature blocks, in which the temperature difference applied to a thermocouple in series with the reference thermocouple in one of the blocks generates a constant bias voltage for the desired offset. The principle of operation is illustrated in Figure 2, showing an example of an Iron-Constantan thermocouple probe at 32°F connected to a 32°F reference junction circuit. The Iron thermocouple input lead is connected to the copper output, the junction temperature being 130°F. If the Constantan input lead were similarly connected to a copper output the effective reference temperature would be 130°F, and the output voltage would be 2.82 mv (as tabulated in any 32°F reference table). Between the Constantan input and copper output there is interposed a Chromel-Constantan thermocouple with a Chromel-Constantan junction at 209°F. This junction introduces a series voltage of -2.82 mv (the difference between Chromel-Constantan entries at 209°F and 130°F in any reference table), and the net output voltage is zero, indicating an effective system reference temperature of 32°F. For thermocouples other than Iron-Constantan, similar ciruits are used with appropriate reference temperature and series thermocouple combinations.

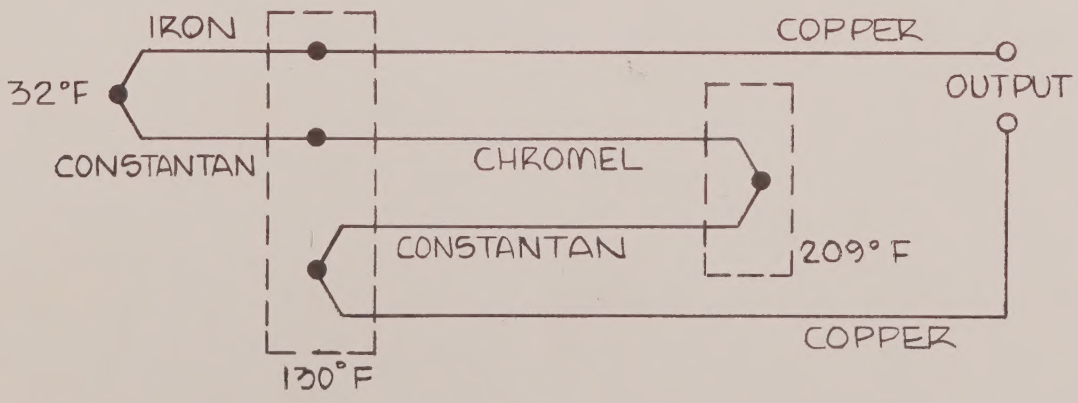

Figure 2

MODEL LRJ43 LABORATORY ICE POINT REFERENCE JUNCTIONS

INTRODUCTION - continued

In the Model LRJ43, the reference thermocouples for each channel (up to eight channels may be included), are electrically insulated and embedded in thermally insulated blocks which are maintained at the proper temperature by an integral resistance bridge temperature sensor and solid state proportional control amplifier system. Each controlled temperature is stable within ±0.1°F. The maximum deviation of any junction from the mean is within ±0.1°F of the set point and overall accuracy of better than ±0.2°F is achieved in most of the usual applications.

The standard Model LRJ43 allows only one thermocouple type in all channels. Various thermocouples at one or several reference temperatures can be accommodated with additional internal circuitry. Also, extremes of hign and low temperature reference can be achieved using series thermopile circuits of appropriate polarity. These units are available on special order.

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MODEL LRJ43 LABORATORY ICE POINT REFERENCE JUNCTIONS

THEORY OF OPERATION

Both thermally insulated blocks are controlled in temperature by similar systems; The low temperature system description follows:

Referring to the Temperature Control Schematic, the system is energized by applying power through the 115 volt 60 cycle line plug and closing switch S101.

Power from T101 is applied to the block heater winding and its control transistor through the bridge rectificer diodes, X105, X106, X107, and X108. This provides a rectified sign wave voltage. This voltage passes through the decoupling diode X104 to filter capacitor C101, providing a filtered DC voltage to operate the control circuitry. The DC voltage is regulated to 18 volts by transistor Q103 and Zener diode X103. This regulated voltage is then applied to a bridge circuit comprised of thermistors R101 and R102, resistors R103 and R104, and two 7 volt Zener diodes X101 and X102. Thermistors R101 and R102 are embedded in the block and sense the block temperature. Resistance values are such that at the desired temperature the bridge is balanced. In this condition there is no voltage between the emitter and the base of transistor Q101. A drop below the set temperature results in an unbalance in the bridge and a current in the base circuit of Q101. The resultant collector current is amplified by Q102 and applied to Q104 causing current to flow in the heater circuit. This current increases until the power being dissipated in the heater winding and Q104, which is mounted on the block, is sufficient to maintain the set temperature. The maximum available heater power is nominally 20 watts. This is sufficient to maintain the block at the set temperature with an outside ambient as low as -65°F.

MODEL LRJ43 LABORATORY ICE POINT REFERENCE JUNCTIONS

OPERATING INSTRUCTIONS

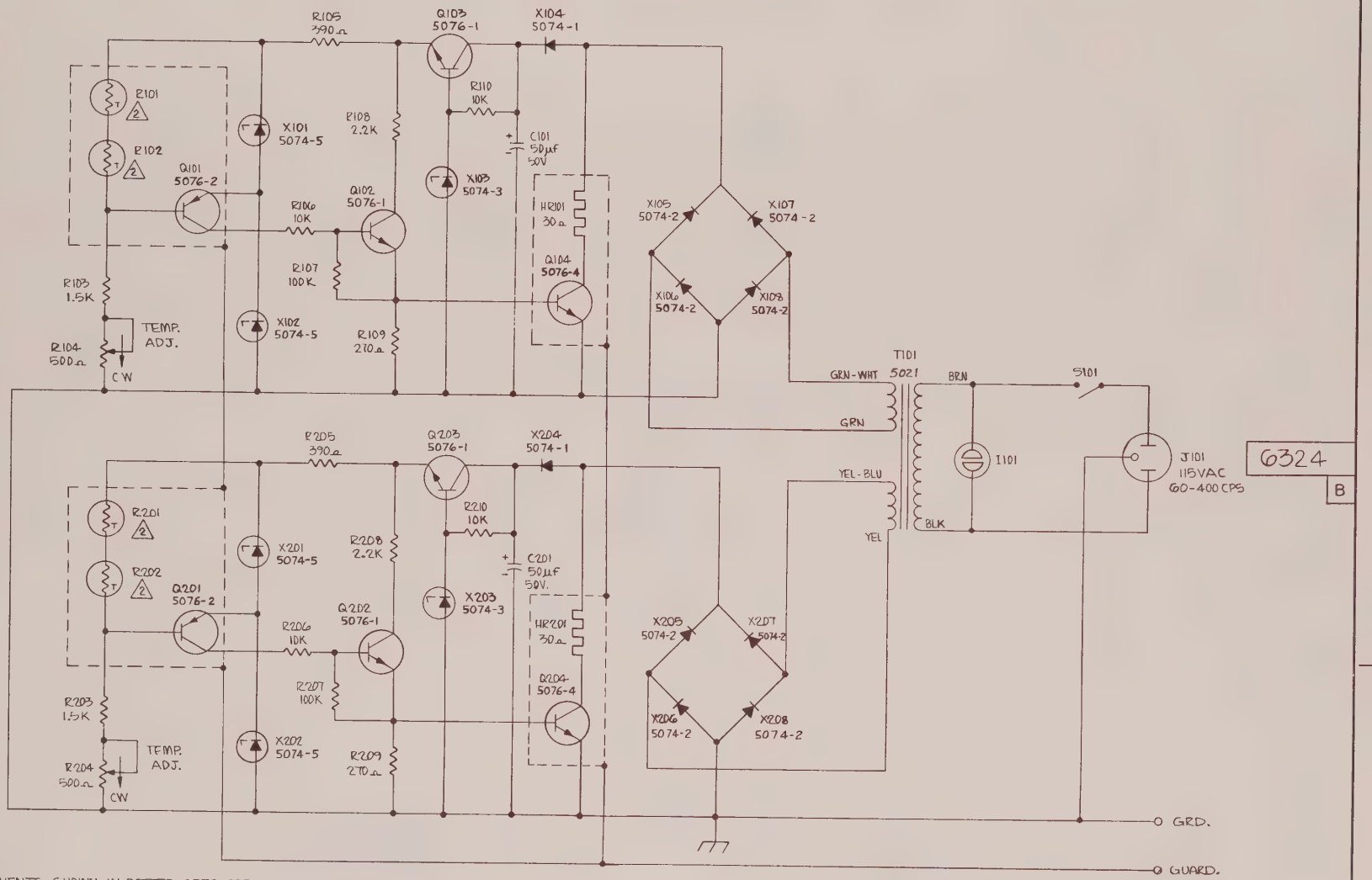
Thermocouple connections to the reference junction are made as shown in the thermocouple wiring diagram. Polarity and material designations must be observed for proper operation.

A connection to the reference temperature blocks, labeled GUARD, is available at the panel and permits grounding at any desired location. Grounding the blocks at the measuring thermocouple location eliminates the effects of AC potential differences between ground at the measuring thermocouple and the reference junction location. A second terminal, labeled GROUND, is located adjacent to the GUARD terminal and is used to connect the blocks to power (and case) ground in systems in which only a small or no AC potential difference exists between the reference junction and the test area.

Reference temperature stability is normally attained in ten (10) minutes after power is applied. Standard reference temperature is 32°F (others available on special order) and may be verified by connecting a calibrated thermocouple at a known temperature to any channel of the LRJ43. Care should be taken to insure that the terminals on the LRJ are not exposed to draft, to minimize errors due to temperature gradients through the terminals.

6324

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	ADDED GUARD AND GRD. TERMINALS.	7-24-65	MK
B	REVISED COMPONENTS IDENTIFICATION	7-27-65	[illegible]



NOTE:

1. COMPONENTS SHOWN IN DOTTED AREA ARE MOUNTED ON HEATED BLOCK.
2. VALUE DETERMINED BY TEMPERATURE RANGE.

TOL. UNLESS NOTED
DEC. XXX ±.002
FRAC. & DEC. XX ±.010
ANGLES ±½°
DIAMETERS WITH SAME ℄ SHALL BE CONCENTRIC WITHIN .005 TIR.
SURFACES MUST BE FLAT WITHIN .002 PER IN.
MAX FILLET .015 UNLESS NOTED.
DEBURR EDGES .005 MAX UNLESS NOTED.
SURFACE FINISH 63 UNLESS NOTED.
DRILLED HOLE TOL. PER AND10387.

SCALE —

PACE *engineering company*
13035 SATICOY STREET, NORTH HOLLYWOOD, CALIFORNIA

DWN	R.S.	2-11-65	MODEL LRJ43
CK'D	[illegible]	2-65	MAT'L
APPVD.			FINISH

TITLE SCHEMATIC, THERMOCOUPLE REFERENCE JUNCTION.

B

8-64 DIETERICH-POST CLEARPRINT 1000H

PARTS LIST: REF. DWG. #6324B

PART NO.	NAME	DESCRIPTION	PACE NO.
C101,201	CAPACITOR	50mfd 50V	5072-9
HR101,201	HEATER WINDING	Wound on block 30Ω	
I101	LAMP	NE51	
J101	CONNECTOR	Power cord #17408-S	
Q101,201	TRANSISTOR		5076-2
Q102,202	"		5076-1
Q103,203	"		5076-1
Q104,204	"		5076-4
R101,201	THERMISTOR	Value to be determined	
R102,202	"	" " " "	
R103,203	RESISTOR	1.5k ±1% 1/4W	
R104,204	POTENTIOMETER	500Ω	5075-7
R105,205	RESISTOR	390Ω ±10% 1/4W	
R106,206	"	10k ±10% 1/4W	
R107,207	"	100k ±10% 1/4W	
R108,208	"	2.2k ±10% 1/4W	
R109,209	"	270Ω ±10% 1/4W	
R110,210	"	10k ±10% 1/4W	
S101	SWITCH	Carling #2GL-63-73	
T101	TRANSFORMER		5021
X101,201	ZENER DIODE		5074-5
X102,202	" "		5074-5
X103,203	" "		5074-3
X104,204	DIODE		5074-1
X105,205	"		5074-2
X106,206	"		5074-2
X107,207	"		5074-2
X108,208	"		5074-2

TERMINAL WIRING

Thermocouple input connections are made at screw terminals in front panel and output connections at the corresponding terminals below.

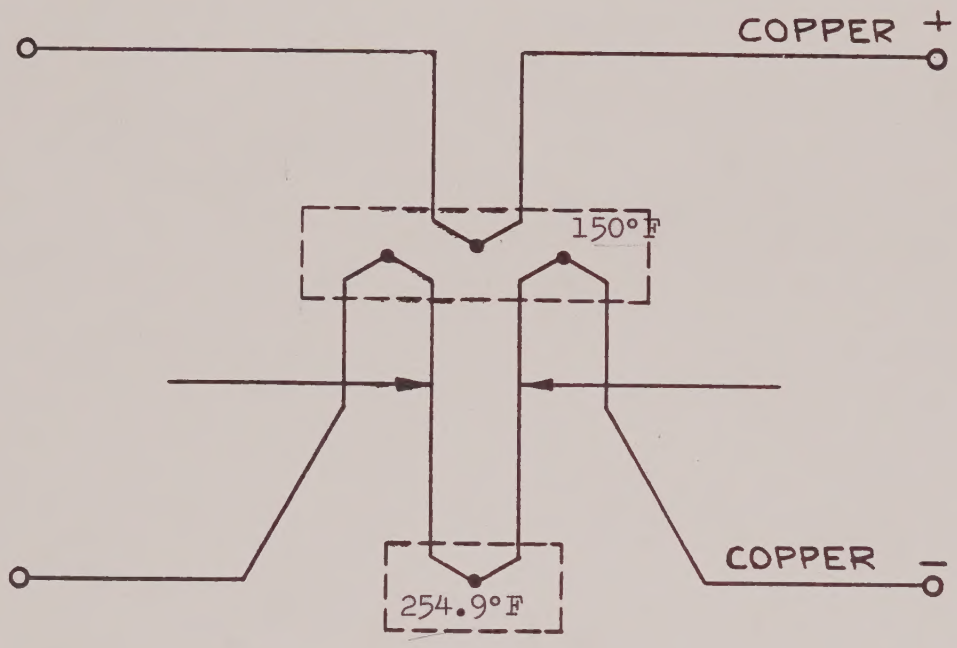
The schematic shows the internal thermocouple circuit.

INPUT

OUTPUT

1-2 CHROMEL
3-4 PLATINUM/
10% RHODIUM

1-2 ALUMEL
3-4 PLATINUM



MODEL: BRJ18

STD. TOL. FRAC: 010 DEC: 002		PACE ENGINEERING COMPANY	
SCALE		FINISH	MODEL
DWN.	CKD.	MAT'L.	NEXT ASY.
		SCHEMATIC, BELOW-AMBIENT REFERENCE JUNCTION	

PACE *engineering company*

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